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ABSTRACT

Focusing on the use of microcomputers as "smart terminals" for accessing time-sharing systems for libraries, this document discusses the communications software needed to allow the microcomputer to appear as a terminal to the remote host. The functions which communications software programs are designed to perform are defined and explained, including communications protocols, keyboard redefinition, screen display, RAM Buffer Operations, uploads, downloads, editing, printer controls, and keyboard macros. The operational aspects which are important for efficient use are reviewed, as well as those which facilitate operator training. Other communications applications for microcomputers are explored, such as electronic mail and bulletin boards, micro-to-micro file transfers, and use of smart terminal software to download data into local files. Because such smart terminal software packages are hardware dependent, information is provided to aid in software examination, which should be conducted as part of the evaluation and selection process if the hardware has not been already purchased. More than 75 software programs are listed, with publisher, price, and hardware information. A glossary and bibliography are provided. (Author/LMM)

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COMMUNICATIONS SOFTWARE FOR MICROCOMPUTERS

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CONTENTS

		Page
Preface		ii
Introduction		1
SECTION 1	FUNCTIONS OF A SMART TERMINAL PACKAGE	2
	1. Communications Protocols	
	2. Keyboard Redefinition	
	3. Screen Display	
	4. RAM Buffer Operation	
	5. Uploads, Downloads and Editing	
	6. Printer Controls	
	7. Keyboard Macros	
SECTION 2	ENHANCING USER SATISFACTION	7
	1. Command Execution	
	2. Status Line	
	3. Default Configurations	
	4. Menu Operation	
	5. Documentation	
SECTION 3	ADVANCED FEATURES AND OPTIONS	9
	1. High Speed Communication	
	2. Auto Dial	
	3. Electronic Mail and Bulletin Boards	
	4. File Transfer Protocols	
	5. Database Creation	
SECTION 4	HARDWARE COMPATIBILITY	12
	1. Serial Interfaces	
	2. Modems	
	3. Display Monitors	
	4. Print Controllers	
Smart Terminal Software		14
Glossary		23
Software Directories		24
Bibliography		25

PREFACE

As microcomputers have become more common in libraries, interest in using them as smart terminals for accessing time-sharing systems has grown also. The use of microcomputers as terminals presents many new opportunities, but also many problems.

The research for this publication was begun in Summer, 1982, as preparation for a presentation at the ONLINE '82 Conference. The original plan of providing a comparison of packages for microcomputer communications was quickly modified, as the plethora of products revealed itself. It became evident that comparisons were next to impossible, given the number of variables involved. It was also evident that the criteria for such comparisons needed to be established, and sources of further information identified.

Microcomputers and their software are a fast-changing field, with new products being announced every month. No published compilation can ever hope to be 100% inclusive or up-to-date. It is for this reason that readers are urged to use the listed programs, prices and features as guidelines only.

It is not the intention here to recommend or endorse particular products, although specific capabilities of individual packages will be noted as examples. The intention is to provide an understanding of the features which are available and desirable in these programs.

The author is indebted to the assistance of Dana Ellingen of DIALOG Information Services, without whose contributions this publication would not have been written.

INTRODUCTION

Microcomputers are a relatively new phenomenon, barely six years old, and they are still a long way from becoming standardized. Their capabilities vary widely, especially among the earlier models (those introduced before 1981). Most microcomputers were not designed with communications as a principal function; they were originally envisioned only as stand-alone processors. Consequently, many microcomputers will require a number of hardware "add-ons" before they will operate as terminals. These "add-ons" might include clocks, serial interfaces, printer controllers, upper/lower case or 80-column displays, and so on. (Some microcomputers, the Apple II in particular, require more "add-ons" than others.) The complete purchase price may increase substantially before the microcomputer is ready to talk to the outside world.

In addition to hardware modifications, a microcomputer also needs appropriate software to allow it to appear as a terminal to the remote host. A few have this capability as part of their Operating Systems, but most of these allow for strictly "dumb" operations only -- i.e., they will send the proper signals back and forth, but not much else. This is not a very effective way to use a microcomputer. What is needed is a "smart terminal" software package.

There are a great number of these packages available now, and more are being released all the time. Do not assume, however, that it will be necessary to evaluate dozens of packages before selecting one to purchase. Virtually all the software packages are quite hardware dependent -- i.e., each will operate on only one or two hardware configurations, including any "add-on" boards or peripherals. Thus, if the hardware has already been acquired, the software selection is greatly narrowed. If the hardware has not been purchased or selected, the software should be examined as part of the evaluation and selection process. This publication is intended to aid in that examination.

SECTION 1 FUNCTIONS OF A SMART TERMINAL PACKAGE

Terminal software packages range from top-of-the-line, do-everything wonders, down to bare basics. They range in price from $35 to $250 or more. The functions of this software include communications protocols, display characteristics, command operations and data transfers. The design of the software has a major impact on its usefulness. When considering the purchase of such programs, examine how thoroughly and easily they perform each of the following operations:

1. Communications Protocols
2. Keyboard Redefinition
3. Screen Display
4. Buffer Operation
5. Uploads, Downloads and Editing
6. Printer Controls
7. Keyboard Macros

1.1 Communications Protocols

Users of computer terminals are so accustomed to having a standard EIA RS-232-C communications port that it can come as something of a surprise to learn that these are anything but standard on microcomputers. The signals generated by the microcomputer may not be compatible with the serial, asynchronous requirements of the distant host. Dumb terminals are largely unconfigurable, so it is transparent to their users that many parameters are involved in "setting up" for communications.

Configuring the communications protocols means determining the word length (number of data bits per character), the number of start/stop bits, and the number and type of parity bits. The same process will usually also encompass setting the baud rate, the duplex (half or full), generation of line feed characters, and various other CONTROL functions. Whatever software package is acquired will have default settings, but since the requirements of the various hosts differ, it is important that the user be able to alter these. The program should then store the changes, so the user need not go through the process every time the software is used.

1.2 Keyboard Redefinition

Another capability that the software should have is character redefinition, which is sometimes referred to as "keyboard mapping." Many microcomputers lack full character sets, and cannot generate all of the ASCII characters or all of the control codes needed to converse properly with the host. (Sometimes the missing codes are quite essential ones, like BREAK.) Other microcomputers may define the function of certain CONTROL or ESCAPE sequences differently than what the host expects or requires. The software should allow the user to alter the code or character that is generated by particular keys or key combinations. These redefinitions should also be stored, so that this step need not be repeated with each use. The better packages allow the user to have it both ways -- the user can retain the original function of the key, and add desired functions through ESCAPE or CONTROL combinations. While this may require that more than one keystroke be used to generate the appropriate signal, at least no functions are lost.

1.3 Screen Display

It is only quite recently that microcomputers have had 80-column displays or upper and lower case character sets as standard features. The smart terminal software can be used to substitute or compensate for these lacks, although more generally the solution is a hardware modification.

When the software is used to generate both upper and lower case the screen may display it by using reverse video. The software will recognize the differences and will send the right signals to the host. This is particularly useful for electronic mail applications, where the use of upper and lower case is more important than for database searching. Generating both upper and lower case characters on the local printer cannot be accomplished by the software alone.

A related function is changing the screen format. The output from the hosts commonly used by libraries is typically in lines of up to 75 characters; without a full-size 80-column display, the hosts' output must be wrapped around to the next line. Smart terminal software can make the display easier to read by breaking the lines at the end of the words rather than arbitrarily in mid-word. The full-length line should still be passed unbroken to the printer, however. Other monitor enhancements can be added by the software. For example, the Dtrans package provides for reverse scrolling of the display.

1.4 RAM Buffer Operation

Perhaps the most important feature to be gained from a smart terminal package is the buffer. This is a section of RAM used for temporary storage of data transmitted between the user and the host. The buffer's contents can then be viewed, edited, saved to disk, dumped to the printer, etc. (The RAM buffer should not be confused with the print buffer which many packages provide. The print buffer is a separate area allocated within the memory.)

The RAM buffer size will vary widely, depending both on the hardware being used and on the terminal software itself. For most purposes, the larger the buffer, the better. The software packages can provide as little as 4K of space, or as much as an entire disk. The buffer needs to be large enough to accommodate both the data to be captured from the host (downloaded) and the data to be sent to the host (uploaded). The program should permit the user to toggle the buffer open and closed without exiting from the TERMINAL program or interrupting the host in any way. This allows the user to be selective about what is captured. The software should also inform the user if the buffer is open or closed, and how much space it has left.

Most software programs will not allow simultaneous receipt of data and saving to disk. This means that to prevent data loss, the SAVE must be done while the host is "on hold," which wastes connect time. The best situation is to have a buffer large enough to capture the entire online session, so that the WRITE to disk can be done while offline. The Dtrans program permits five open buffer files to place data in, simultaneously. Another package, Crosstalk, allows the user to capture directly onto disk rather than into buffer, but the function depends on using the XON/XOFF protocols, which are not available on DIALOG, BRS, or some other hosts.

Be wary of how the buffer operates. On some packages, re-opening the buffer erases its current contents. As a consequence, if the user has forgotten to WRITE the contents to disk after the last close of the buffer, whatever was in it will be lost. Another problem area is the BUFFER FULL message, which some packages will not give until already out of space. Most will simultaneously send the host an XOFF to halt the data flow, but since many hosts unfortunately will ignore this signal, some of the data will be lost. The Transend package sounds a warning "bell" when the space remaining in the buffer goes below 3K.

1.5 Uploads, Downloads and Editing

Capturing data from the host (downloading) and sending pre-constructed text back (uploading) are among the major justifications for using a microcomputer for communications. In order to perform these transfers, the user must be able to create and manipulate text. This means an editor is needed. Some terminal packages include an editor, others provide compatibility with standard word processing packages for the same hardware, so that files can be used and manipulated within both programs. Sterm does this for Scripsit and Electric Pencil, for instance, as does Commwhiz. Still other packages both create short text files within the terminal program, and utilize other files created by the word processing package or operating system. You should beware of terminal programs that can do neither, as with the TRS-80 Model II "Terminal" function. They will leave the user with downloaded blocks of unalterable text; uploads are not possible at all.

Whatever editor is being used, be certain that the transfer process allows for imbedding CONTROL characters. This allows instructions to the host to be included in uploaded text, without them being acted on by the microcomputer. It is also important to be able to instruct the microcomputer to ignore certain characters or CONTROL sequences transmitted by the host -- top of form, clear screen, change screen characteristics, etc. -- which could cause unwanted reactions.

The better smart terminal programs allow the user a variety of ways to perform uploads. Most all will allow dumping of a block of text (or the contents of the buffer) to the host. But not all hosts can accept large uninterrupted streams of data. The software should allow the user to choose between transmitting a block, or a line at a time. If transmitting a block, which is really a stream of characters in asynchronous transmission, the user should be able to insert delays between characters. This does not alter the baud rate. Zterm provides six stepped delays in addition to a Carriage Return delay; Commwhiz has nine stepped delays.

When transmitting line by line, even more control of the data flow is needed. The microcomputer must recognize when it has reached the end of a line to be uploaded (usually by a CR/LF). It must also recognize, as part of the configurations for that host, the prompt character(s) to wait for before sending the next line (i.e., whether the host uses a question mark, underscore/colon, greater than, or other characters). Alternatively, there are other mechanisms for controlling the data flow. Some packages use a WAIT (defined as a number of seconds) or else define the number of characters to be received from the host before sending the next line.

1.6 Printer Controls

It may surprise some novice microcomputer owners to learn that many of these machines cannot simultaneously print and perform other functions. Any good terminal software package should include controls for the local printer. The importance of local hard copy does not decrease with the change from dumb terminal to communicating microcomputer; however, the manner in which the printer is utilized may change a good deal.

There is wide variation in the way software packages produce printer output. Some allow printing directly from the incoming modem line, some will print directly from the RAM buffer while data is incoming, others allow printing only when the communications line is "quiet." The user should consider very carefully whether it is important to print while in TERMINAL mode, and in what volume. Since it is unusual to want to print everything coming over the line (and into the RAM buffer), the program should have a simple way of toggling the printer on and off without interrupting other functions unduly.

In addition to simply turning the printer on and off, the software should provide some interface or controls over the print speed. Printers that can keep up with high-speed output are costly compared to the slower models, and the typical printer sold with a microcomputer system may be even slower (particularly in perfoming carriage returns) than teleprinters. Unless the software provides some controls, the printer will fall behind the data stream and lose characters.

These speed controls can be in the form of a separate print buffer or spooler. This is an area of the RAM that is allocated to compensate for the difference between the speed of data reception and the speed of printing. The print buffer receives data at the same rate as the modem, but releases it at the speed of the local printer. The size of the print buffer can be small (Zterm allows 255 characters) or large (Transend sets no limit). Other programs rely on XON/XOFF controls or other techniques. How well the controls work may depend in part on what type of printer is used, as they must interact properly.

1.7 Keyboard Macros

Automatic logon is one of the features that every searcher of online database systems associates with the joys of owning a microcomputer: no more remembering passwords, terminal identifiers, etc., etc. Users should be aware, however, that there is considerable variation in the provisions that the terminal software packages make for these functions. Storing and automatically transmitting strings of characters are referred to as Keyboard Macros. Some terminal packages have very limited parameters for macros (i.e., only so many strings, of so many characters). Some tie each string to a particular key; others allow the user to program one or more groups or sets of such strings. The Crosstalk package allows four strings of fifty characters each. Some of the packages allow as many as can be stored in a certain space: Zterm provides a maximum of 2K, Datalink allows 1K.

Be careful about whether, and how, these macros incorporate control codes, as some logon sequences need to use them. Two programs, Recall and Terminal Program, have taken a very clever approach to creating logon macros. These software packages simply capture the entire sign-on

process during the initial (manual) session. At later sessions, the software repeats the user input to the hosts' prompts. If the host changes the procedure, the packages just capture it again.

Some packages will link the logon macros to configuration sets or to host names and telephone numbers, so that the same command which specifies which host to contact also calls up the appropriate macro. This is an obvious convenience to the user.

SECTION 2 ENHANCING USER SATISFACTION

In addition to performing all of the functions listed in the previous section, the terminal software needs to be easy to use. If it is difficult, cumbersome, time-consuming, error-prone or frustrating in any way, you will be better off with a dumb terminal. There are a lot of packages available that do almost everything one could want them to do, but they do it in a manner that is less than acceptable.

Some of the provisions which a well-designed software package will make for user happiness are:

1. Command Execution
2. Status Line
3. Default Configurations
4. Menu Operation
5. Documentation

2.1 Command Execution

Virtually every software package will have at least two operating modes, one for COMMAND level or local interaction between the user and the microcomputer, and another TERMINAL mode for conversing with the host mainframe. The program can only be in one mode at a time, so a mechanism must be provided for switching back and forth. Most packages do allow the user to perform COMMAND functions without disconnecting the communications line, but not all will allow this to happen without losing whatever the host has transmitted while the user was "away." Similarly, some may continue to capture the host's transmissions into the memory, but will not restore it on the screen display when returning to TERMINAL mode. (Commwhiz is one that does restore the screen display.)

The mechanism which allows the user to change modes is usually a CONTROL or ESCAPE sequence. Sometimes this is a single keystroke, sometimes more. The return (from COMMAND to TERMINAL mode) may be accomplished automatically after completion of each COMMAND function, or may require an additional keystroke or menu selection. Obviously, the fewer keystrokes that are required, the faster the user will be able to perform the desired operation. A few of the better packages allow the performance of certain functions (open/close buffer, printer on/off) without leaving TERMINAL mode at all.

One feature to look for is the ability to redefine what key(s) are used to reach COMMAND mode, or some other way of retaining their operation with the host. An example of this would be where the program defines ESCAPE as the exit to COMMAND mode, but the host uses ESCAPE as an interrupt signal. It is desirable to have both functions available.

2.2 Status Line

Another very useful feature to have, which will contribute to smooth operation, is a "status line." This is simply a line on the screen, usually at the very top or very bottom, that tells the user what the current settings are. This can include communications protocols that have been selected (helpful in identifying transmission problems), whether the RAM buffer is opened or closed and how much space is left in it, whether the printer is on or off, whether auto-linefeed is enabled, and so on. Being able to check on any of these conditions without exiting

from the online conversation is quite helpful. A few packages enlarge on the status line by including in it a list of the key commands.

2.3 Default Configurations

A feature whose importance may not be anticipated by a user of dumb terminals is the ability to store operating parameters, preferably in multiple sets tied to each individual host. Because the online hosts do have very different requirements, a program that stores and loads only one such configuration will be inconvenient at best. Some software packages are supplied with the operating parameters already installed for the most popular hosts -- Source, CompuServe, Dow Jones, DIALOG -- and also have the ability to create new configuration sets.

2.4 Menu Operation

It is generally accepted that the best way to structure communications software is to make it menu driven. This means that for any function, the user is prompted to select from a menu of options. Certainly it is less strain on the human memory to select from a list of choices than it is to remember what all the possible alternatives are. But the very experienced user may also get quite annoyed at being forced to look at a menu for every single operation, (or even more than one menu, such as Transend uses). The user must judge what his tolerance is for menus and sub-menus (sometimes called tree structures), or for a system that asks him to verify ("Are you sure? Y/N") even routine selections. On the whole, one is better off having the menus, but some perform more nicely than others. A few packages allow the experienced user to bypass the menu displays by "typing ahead" or using a different CONTROL sequence.

2.5 Documentation

The user manual itself is a critical factor in the success of the software package. Unfortunately, the failings may not reveal themselves until the user is tangled in error messages. Most reviewers of software packages will have a word to say about error handling and documentation; don't disregard these final-paragraph remarks. Look for indexes, logical organization, reference cards or command summaries, and training exercises or sample sessions. The manual for Visiterm includes a "Primer on Data Communications" and "Introduction to Communication Cards;" Micro/Terminal gives a telecommunications overview and ASCII character code chart. All are very useful items. Although good documentation dos not guarantee a good program, poor documentation can ruin the usefulness of excellent ones.

SECTION 3 ADVANCED FEATURES AND OPTIONS

There are other features that are frequently found in these software packages. While they can contribute much to user satisfaction, they are considered unnecessary by some people. The features may expand the applications that are available to the user beyond simply interacting with a host. Some of these functions are:

1. High Speed Communication
2. Auto Dial
3. Electronic Mail and Bulletin Boards
4. File Transfer Protocols
5. Database Creation

3.1 High Speed Communication

Communication speed is a variable that depends on both hardware and software to function, and most of the current packages are 300 baud only. It is very desirable to have faster communications, both to reduce connect charges on timesharing and telecommunications systems, and for human reasons. The user will find the amount of time spent sending or receiving large files at low speed to be frustrating and wasteful. Unfortunately, many of the current software packages were written before the recent drop in modem prices, and consequently did not anticipate the demand for 1200 baud compatibility. Many packages are being revised for 1200 baud, as the 300 baud modems have really lost their low-price advantage.

3.2 Auto Dial

The most commonly found enhancement is automatic telephone dialing from a directory of stored numbers. The software provides the proper instructions to the modem to make the connection. The function is often linked to the host logon macro (see Section 1.7). Automatic dialing cannot be accomplished by the software alone; it will only work in conjunction with the appropriate hardware.

Automatic dialing can be a great saver of time and frustration for the user, especially if more than one telephone number is accessed often. Packages that support automatic dialing will usually support re-dialing also, so busy ports are no longer such an annoyance. Some packages will "link" numbers, so that a busy signal or no answer will result in the software trying an alternate number for the same host.

3.3 File Transfer Protocols

So far, the emphasis has been on communications where the microcomputer and software function regardless of what is on the other end of the line. There are a number of other applications that are available when the system is operating in pairs -- i.e., where there is a microcomputer on the other end of the line, running the same software package. The most common use for such connections is to transfer programs, as opposed to text.

When transferring non-text files, it is highly desirable to use some form of error checking. Several software packages incorporate this feature, using a variety of techniques such as checksum verification to detect and correct errors.

Some packages will translate certain error-prone characters prior to transferring files, such as changing tab characters to eight spaces. This enables the files to be used by communicating word processing systems, an application that more and more organizations are finding useful. Other packages will translate entire files from ASCII to binary, from BASIC to CP/M-based operating systems, or from "compressed" to "uncompressed" formats. All of these abilities are useful if the user expects to be involved in transferring program files.

The Move-It program is specifically designed to aid file transfers between microcomputers, as opposed to microcomputer-to-mainframe communications. Micro/Courier is another package aimed at microcomputer pairs, and will even transfer graphics files.

3.4 Electronic Mail and Bulletin Boards

Another frequent application requiring pairing of the software -- having it at both ends of the communications link -- is electronic mail. (This would be for "private" electronic mail networks or electronic bulletin board services, which are accessed by users dialing into a host microcomputer rather than a timesharing network or mainframe.) While libraries doing only online retrieval may not have a need to dial into their resident microcomputers, it makes a great deal of sense for these other applications.

If the hardware and software are appropriate and compatible, such operations can be conducted unattended. Several packages are available which allow for automatic origination and answering of telephone calls, without any human intervention. Some communications packages which specifically address these applications are: MicroCourier, Online, Transend 3, CommuniTree. This application does result, however, in the microcomputer being "dedicated" to this function alone. Personal computers are not designed for a multi-tasking environment, and can only run one operation at a time. Therefore, when the software for the electronic mail is loaded, no other functions (word processing, financial planning) can be run.

Other applications related to electronic mail may include compatibility with non-telephone communications systems. This is important for business and library users. There are software packages that can provide compatibility with the Western Union network, for instance. Micro-Telegram is specifically designed for this, and will automatically format text for TWX, Telex and other Western Union InfoMaster services. Another program designed for this purpose is TXL=Telex Link.

3.5 Database Creation

All of the communications software packages will allow the user, to one extent or another, to download information -- i.e., data from the host can be captured into local memory. However, the captured text usually can be utilized only for word processing. There is no easy way to transfer the file into a database management system, where it would be possible to merge, search, sort or otherwise manipulate the data as if it were a locally created file. The only way this can be done is for the user to create the necessary programming locally.

Significant progress is being made in the direction of a generalized data-capture-file-creation package. Several products that provide the ability to download off their host systems into a local database format have been released by online vendors and database publishers. ISI's PRIMATE, BIOSIS' BITS, and Disclosure's micro-DISCLOSURE programs are all specific to their own databases. BRS' SEARCH and Cuadra Associates' STAR are more sophisticated (and more costly, both for software and hardware), and will perform downloading from any host so long as the data is formatted with recognizable tags. Neither of these, however, will run on anything that can be termed a "personal" computer.

Non-bibliographic databases and vendors are also progressing in this direction. DRI will now provide for downloading from their host into a Visicalc spreadsheet. Dow Jones is now selling software that allows for the collection and analysis of stock data from the Dow Jones News Retrieval Service.

SECTION 4 HARDWARE COMPATIBILITY

Smart terminal software packages are, for the most part, not transferable between machines. Each package is written for a specific hardware and operating system configuration; only a few packages provide much flexibility in this area. Potential purchasers should investigate this aspect very carefully. In addition to problems with compatibility, novice microcomputer users should be aware of the number of hardware "add-ons" that must be acquired in order for the microcomputer to function satisfactorily as a remote-access terminal. These "add-ons" must also be compatible, with both the software and each other.

4.1 Serial Interfaces

The signals generated by the microcomputer and its operating system may not match the asynchronous communications requirements of the distant host. If the microcomputer has not been designed with a serial port, the first "add-on" that will be needed is a serial interface board and a clock that will enable the microcomputer to generate the proper signals for the modem and thus the host. Most of the newer machines will not require any modifications or enhancements in this area, as communications is now regarded as an important user priority.

4.2 Modems

1200 bps modems for microcomputers have been introduced only very recently, as the previous $800-plus prices were a real barrier. Consequently, few software packages were written or modified for the higher speeds. This situation can be expected to change rapidly, now that the 1200 bps modems are so much more affordable.

1200 bps modems designed for use with terminals may need different cables when used with microcomputers. For instance, in order to be able to print simultaneously with the host's data transmission, you may want to get a "Y" or splitter cable that will route the data both to the modem and to the printer.

In order to support the automatic dialing features of the software, the modem must be designed for keyboard dialing. It must also be of the "direct connect" type, using the small plug-in RJ11C telephone jack. An acoustic coupler can not be used for automatic dialing.

Other types of modems, quite recently introduced and not yet in wide use with microcomputers, are those incorporating many of the functions more usually performed by smart terminal software. They are costly, ranging in price from $1000 to $3000, but they add some advantages. These "intelligent modems" can perform such operations as automatic telephone dialing and re-dialing, logon macros, and unattended origination or answering of calls without any assistance from the CPU or software. With up to 48K of memory, text editing can be done on uploaded and downloaded files. Some, like the CLASS Messenger, have features designed for electronic mail applications (prompted forms, TWX compatibility). Others, such as the Userlink, allow limited programming functions (sorts, searches). The greatest advantage of these modems is that they can take over answering incoming electronic mail or bulletin board calls independently, and allow the microcomputer to be used for other functions whenever necessary.

Some terminal software packages will support a wide range of modems and interface boards, while others are quite limited. The compatible modems are generally clearly stated in the software specifications. The most widely used are those from Hayes Microcomputer Products and Novation, in part because those companies have actively sought the microcomputer market. There are now also a number of firms selling both the modems and smart terminal software, sometimes as a "package deal."

4.3 Display Monitors

The microcomputer display, when used for remote terminal functions, should be able to generate both upper and lower case, in an 80-column format. It should also be able to scroll at least fast enough to keep pace with 1200 baud transmissions from the host. Because these features were not provided on some "personal" computers, most notably Apple, numerous other manufacturers have introduced plug-in boards with the features. The smart terminal packages may be written for one specific manufacturer's boards; as with the modems, this should be checked against the software's specifications.

4.4 Printer Controllers

Microcomputers can seldom "think" and print at the same time, and the printers sold with them tend to be slow. Even if the smart terminal software provides some printer controls and memory space for a print buffer, some hardware modifications might be worthwhile to investigate. An additional board for the microcomputer can relieve the CPU of the controller operations, and possibly provide a print buffer as well. There are also a number of separate peripherals which perform spooler operations. These devices can add up to 256K of memory, as well as other enhancements. Some incorporate page formatting, XON-XOFF controls, etc. Many of these peripherals can accept input at a very high rate and output it to the printer at a slower rate. This has the advantage of both "releasing" the CPU for other operations more quickly, and preventing data loss.

The plug-in boards are, of course, designed for specific microcomputers; the separate peripherals are more transportable. They simply emulate a printer, and are transparent to the CPU. They are among the more popular hardware enhancements, and have many uses beyond those associated with interactive or smart terminal operations.

SMART TERMINAL SOFTWARE

Program	Producer	Computer	Price
Access III	Apple Computer 10260 Bandley Drive Cupertino, CA 95014 (408) 996-1010	Apple III	150.00
AMCALL	Digital Marketing 2670 Cherry Lane Walnut Creek, CA 94596 (415) 938-2880	CP/M systems	95.00
Answering Machine	Telephone Software Connection, Inc. P.O. Box 6548 Torrance, CA 90504 (213) 516-9430	Apple II	35.00
Apple Bulletin Board System	Software Sorcery 7927 Jones Branch Dr. Suite 400 McLean, VA 22102 (703) 385-2944	Apple II	74.95
Apple-Link	Computer Applications 13300 SW 108 St. Circle Miami, FL 33186 (305) 385-4277	Apple II	59.95
Appletel 2.0	Logica, Inc. 666 Third Ave., 19th Fl. New York, NY 10017 (212) 599-0828	Apple II	85.00
ASCII Express II	Southwestern Data Systems P.O. Box 582 Santee, CA 92071 (714) 562-3670	Apple II	79.95
ASCII Express Professional	Southwestern Data Systems P.O. Box 582 Santee, CA 92071 (714) 562-3670	Apple II	129.95
ASCOM	Dynamic Microprocessor Associates 545 Fifth Ave. New York, NY 10017 (212) 687-7115	IBM PC	175.00

Program	Producer	Computer	Price
ASCOM	Westico, Inc. 25 Van Zant St. Norwalk, CT 06855 (203) 853-6880	CP/M systems	175.00
Async	IE Systems, Inc. 112 Main St. P.O. Box 359 Newmarket, NH 03857 (603) 659-5891	CP/M systems	245.00
Asynch Communications Support	IBM Information Systems P.O. Box 1328 Boca Raton, FL 33432 (305) 998-6000	IBM PC	40.00
Automated Communications Exchange	Ace Computer Products 640 NW 3rd St. Deerfield Beach, FL 33441 (305) 427-1257	TRS-80 I, III	79.00
Basic Interactive Terminal Software	Software Sorcery 7927 Jones Branch Dr. Suite 400 McLean, VA 22102 (703) 385-2944	Apple II	54.95
BDSC	Automata Design Assoc. 1570 Arran Way Ft. Washington, PA 19025	CP/M systems	[n.a.]
BSTMS	Lifeboat Associates 1651 Third Ave. New York, NY 10028 (212) 860-0300	CP/M systems Heath TRS-80	400.00
Chat	Lovell's 4205 Biltomore Corpus Christi, TX 78413 (512) 852-3096	Apple II	40.00
CLINK/A	Mycroft Labs, Inc. P.O. Box 6045 Tallahassee, FL 32301 (904) 385-2708	Apple II	145.00
CLINK V 3.3	Mycroft Labs, Inc. P.O. Box 6045 Tallahassee, FL 32301 (904) 385-2708	CP/M systems	200.00
Colorcom/e	Eigen Systems Box 10234 Austin, TX 78766	Eigen	49.95

Program	Producer	Computer	Price
Comm-Pac	Apple Computer, Inc. 20525 Mariani Dr. Cupertino, CA 95014 (408) 996-1010	Apple II	85.00
Commun I	Potomac Micromagic, Inc. 5201 Leeburg Pike #604 Falls Church, VA 22041 (703) 379-9660	CP/M systems	30.00
CommuniTree	CommuniTree Group 470 Castro St. San Francisco, CA 94114 (415) 474-0933	Apple II	120.00
COMMWHIZ	VolksMicro Computer Systems, Inc. 202 Packets Ct., Suite C Williamsburg, VA 23185 (804) 220-0005	TRS-80 I, II	79.95
COMMX	Hawkeye Grafix 23914 Mobile Canoga Park, CA 91307 (213) 348-7909	CP/M systems	75.00
CONECT	Vector Graphic Inc. 500 N. Ventu Park Rd. Thousand Oaks, CA 91320 (805) 449-5831	Vector	150.00
Connector	Context Management Systems, Inc. 23864 Hawthorne Blvd. Torrance, CA 90505 (213) 378-8277	Apple II/III	180.00
Converse	Select Info. Systems 919 Sir Francis Drake Kentfield, CA 94904	IBM PC	200.00
CROSSTALK	Microstuf, Inc. P.O. Box 33337 Decatur, GA 30033	IBM PC CP/M systems	100.00
CSCS Communications	Computer & Statistical Consulting Services P.O. Box 5351 Terre Haute, IN 47805	IBM PC Seattle	95.00 160.00
CSI Auto-Modem	Computer Stations, Inc. 11610 Page Service Dr. St. Louis, MO 63141 (314) 432-7019	Apple II	39.95

Program	Producer	Computer	Price
DTRANS	Automata Design Assoc. 1570 Arran Way Dresher, PA 19025 (215) 646-4894	CP/M systems	60.00
Data Capture/ Smarterm	Southeastern Software 6414 Derbyshire Dr. New Orleans, LA 70126 (504) 246-8438	Apple II	89.95
Datacomm Pascal	Hayes Microcomputer Products, Inc. 5835 Peachtree Corners East Norcross, GA 30092	Apple	50.30
DataLink	Link Systems 1640 - 19th St. Santa Monica, CA 90404 (213) 453-1851	Apple II	100.00
Data*Trans	ABT Microcomputer Software 55 Wheeler St. Cambridge, MA 02138 (617) 492-7100	Apple II	100.00
Dow Jones News Retrieval	Dow Jones & Co. P.O. Box 300 Princeton, NJ 08540 (800) 257-5114	TRS-80	[n.a.]
Easy Com	Digilog Business Systems, Inc. 1370 Walsh Rd. Montgomeryville, PA 18936	CP/M systems	95.00
Easy Mover	IUS [n.a.]	Apple	99.95
Flexiterm	Computer Stations Inc. 11610 Page Service Dr. St. Louis, MO 63141 (314) 432-7019	Apple II	74.95
Hayes Terminal Program	Hayes Microcomputer Products 5835 Peachtree Corners East Norcross, GA 30092	Apple II	99.00
Hello, Central!	Advanced Operating Systems 4300 W. 62d Ave Indianapolis, IN 46268	Apple II	99.95

Program	Producer	Computer	Price
ICOMM	Smith Educational Engineering Service, Inc. P.O. Box 244 Arlington Heights, IL 60006	IBM PC	100.00
Intercom	End of File, Inc. 3240 East Showlawn Ave. Atlanta, GA 30305 (404) 233-9825	CP/M systems	75.00
InterLync	Starside Engineering P.O. Box 18306 Rochester, NY 14618	IBM PC	100.00
ITCOM2	COMMSOFT, Inc. 665 Maybell Ave. Palo Alto, CA 94306	Heath	49.95
I/TERM	Infosoft Systems, Inc. 25 Sylvan Road, So. Westport, CT 06880 (203) 226-8937	TRS-80 Cromemco North Star Altos	95.00
Link 125	Hewlett-Packard 1501 Page Mill Rd. Palo Alto, CA 94304 (415) 857-1501	HP-125	125.00
LogOn	Ferox Microsystems 1701 North Fort Myer Dr. Suite 611 Arlington, VA 22209 (800) 336-5496	IBM PC Apple II,III TRS-80 II DEC Pro	150.00
Lync	International Software Alliance 1835 Mission Ridge Rd. Santa Barbara, CA 93103 (805) 966-3077	IBM PC TRS-80 I, III CP/M systems	125.00
Magic Messenger	Peachtree Software 3445 Peachtree Rd. NE Atlanta, GA 30326 (404) 262-2376	CP/M systems	[n.a.]
MET/TTY	Metrotech Mgmt. Tech. Waterloo Rd Uxbridge, Middlesex UB8 2YW, Great Britain	Dynabyte Northstar Vector Graphics	200.00
Micro/Courier	MICROCOM 1400A Providence Hwy. Norwood, MA 02062 (617) 762-9310	Apple	250.00

Program	Producer	Computer	Price
Micro Link	Microcomputer Software Associates 1122 B St. Hayward, CA 94541 (415) 534-2212	CP/M systems Osborne IBM PC	89.00
Micro/Telegram	MICROCOM 1400A Providence Hwy. Norwood, MA 02062 (617) 762-9310	Apple II	250.00
Micro/Terminal	MICROCOM 1400A Providence Hwy Norwood, MA 02062 (617) 762-9310	Apple II/III	84.95 to 99.95
Micro-Connection	Microperipheral Corp. 2634 151st Place NE Redmond, WA 98052 (206) 881-7544	TRS-80	249.00
MicroTerm 1.1	Micro Systems Software 4301 - 18 Oak Circle Boca Raton, FL 33431	TRS-80 I, III	79.85
MLS 100	Maxwell Library Systems Suite 206 186 Alewife Brook Pkwy Cambridge, MA 02138 (617) 661-5961	TRS-80 I, III	149.00
Modem	CP/M Users Group 1651 Third Ave. New York, NY 10028	CP/M systems	free
MORTTY	Phillip L. Emerson 3707 Blanche Cleveland Heights, OH 44118	Heath/Z-89	100.00
Move-it	Woolf Software Systems 23842 Archwood Street Canoga Park, CA 91307 (213) 703-8112	CP/M systems	99.00
Nekom	Nektar Computers P.O. Box 29146, Sunnyside 0132, PTA South Africa Pretoria	CP/M systems	86.50
NET-WORK-PLUS (was PET-TERM)	Universal Software Corporation 500 East Oak St. Fort Collins, CO 80524 (303) 221-5367	Commodore 8000 Commodore 9000	[n.a.]

Program	Producer	Computer	Price
OMNILINK	Omnitec Data 2405 So. 20th St. Phoeniz, AZ 85034 (800) 528-8423	Apple II	750.00 (incl. modem)
OMNITERM	Lindberg Systems 41 Fairhill Road Holden, MA 01520 (617) 852-0233	TRS-80 I,III	95.00
Online	Southwestern Data Systems P.O. Box 582 Santee, CA 92071 (714) 562-3670	Apple II	89.95
Ozmosis	Acquis Data Inc. 17192 Gillett Irvine, CA 92714 (714) 545-3732	Osborne CP/M systems	[n.a.]
PC Modem	Solution Software Systems 3930 Whispering Trails Hoffman Estates, IL 60195 (312) 893-5111	IBM PC	50.00
PC Talk	Headlands Press P.O. Box 862 Tiburon, CA	IBM PC	25.00
P.I.T.S.	Software Sorcery 7927 Jones Branch Dr. Suite 400 McLean, VA 22102 (703) 385-2944	Apple II	54.95
P-Term Professional	Southwestern Data Systems P.O. Box 582 Santee, CA 92071 (714) 562-3670	Apple II w/Pascal	129.95
Pony Express	Philadelphia Consulting Group, Inc. P.O. Box 102 Wynnewood, PA 19096 (215) 649-1598	TRS-80 III	140.00
QS Smart Terminal	Quality Software 6660 Reseda Blvd., #105 Reseda, CA 91335	Sorcerer	49.95
Reach	The Software Toolworks 14478 Glorietta Drive Sherman Oaks, CA 91423 (213) 986-4885	Heath H-89 Zenith Z89	19.95

Program	Producer	Computer	Price
Recall	Adaptive Communications 380 Everett Ave. Palo Alto, CA 94301 (415) 326-0359	IBM PC	200.00
SMART/SMART II SMART III	Microperipheral Corp. 2643 151st Place NE Redmond, WA 98052 (206) 881-7544	TRS-80 I, II	99.95
Smart Terminal 80	Business Systems Group 6 Carlisle Rd. Westford, MA 01886	TRS-80 I, III TRS-80 II	150.00 250.00
SOFTCOM	The Software Store 706 Chippewa Square Marquette, MI 49855 (906) 228-7622	CP/M systems	150.00
Softerm	Datasoft [n.a.]	TRS-80 I, III	49.95
STCP	Eastern House Software 3239 Linda Dr. Winston-Salem, NC 27106	Commodore	129.95
STERM	Howe Software 14 Lexington Rd. New York, NY 10956	TRS-80 I,III	69.00
Telcom	Mumford Micro Systems Box 435-C Summerland, CA 93067	TRS-80	39.95
Telelink	Atari 1265 Borregas Ave. Sunnyvale, CA 94086 (408) 745-2000	Atari 400/800	25.00
Teleterm Communications System	Telexpress, Inc. P.O. Box 217 Willingboro, NJ 08046	TRS-80 III	125.00
Term II, XTerm	Supersoft Assoc. P.O. Box 1628 Champaign, IL 61820 (217) 359-2112	CP/M systems	200.00
Termcom	Termcom 5766 Balcones St. Austin, TX 78731 (512) 451-0221	TRS-80	70.00

Program	Producer	Computer	Price
Terminal Emulator II	Texas Instruments, Inc. P.O. Box 10508 Lubbock, TX 79408 (800) 858-4565	TI 99/4	[n.a.]
Terminal Program	Telephone Software Connection, Inc. P.O. Box 6548 Torrance, CA 90504	Apple	35.00
T.H.E. Smart Terminal	Binary Corp. 3237 Woodward Ave. Berkeley, MI 48072 (313) 548-0533	Atari 400/800	49.95
Transend (1,2,3)	SSM Microcomputer Products 2190 Paragon Dr. San Jose, CA 95131	Apple II	89.00 to 275.00
TSMART	Microperipheral Corp. 2643 151st Place NE Redmond, WA 98052	Atari 800	79.95
TXL=Telex Link	Cawthon Scientific Group 24224 Michigan Ave. Dearborn, MI 48124 (313) 565-4000	CP/M systems	350.00
UNITERM	B.T. Enterprises Apparat, Inc. 4401 So. Tamarac Pky Denver, CO 80237	TRS-80 I, III	89.00
Videoterm	Videx [n.a.]	Apple	37.00
VisiTerm	VisiCorp 2895 Zanker Road San Jose, CA 95134	Apple II	100.00
V-Link	Datamark Business Systems 279 S. McKnight Rd. St. Paul, MN 55119 (612) 738-9111	Vector Graphic	250.00
Z Term, Z Term Pro	Southwestern Data Systems P.O. Box 582 Santee, CA 92071 (714) 562-3670	Apple II	99.95 to 149.95

GLOSSARY

acoustic coupler	Device which converts the computer's digital signals into audible tones which can be carried on telephone lines, and vice versa. Connects to the telephone handset with rubber cups.
ASCII	Acronym for American Standard Code for Information Interchange. Uses seven bits plus one parity bit for each of the 96 alphanumeric and 32 control characters.
asynchronous	Data transmission using Start and Stop bits for each character.
baud rate	Speed of transmission measured in number of signal changes per second. Often used interchangably with bits per second (although not truly synonomous).
bps	Bits per second.
buffer	Storage area for blocks of data.
cpu	Central processing unit. Controls the interpretation and execution of program instructions.
EIA interface	International standard for the connection between a terminal and a modem. Specifies the wires that carry data and control signals.
modem	Modulator/Demodulator. Performs identical function to acoustic coupler, but uses direct wiring into telephone rather than cupping to the handset.
RAM	Random Access Memory.
RS232C	See EIA interface.
serial interface	Provides communication path for one bit at a time, as opposed to a parallel interface which uses multiple paths to carry 8 bits (usually) at a time.
spooler	Temporary storage device or area of memory where data is held until it can be printed or processed.

SOFTWARE DIRECTORIES

Note: These sources contain detailed information on the listed programs. In addition, many journals carry frequent lengthy reviews of newly released software. These can be identified through the Microcomputer Index.

Apple II Blue Book, Chicago, WDL Video, 1982.

Freeloader 500 Software Library, Washington, American Software Publishing Co., 1982.

International Microcomputer Software Directory, Imprint Editions, Ltd. (Also available as File 232 on DIALOG.)

Micro Software Report: Library Edition, Torrance, CA, Nolan Information Management Services, 1982.

Microcomputer Index, Santa Clara, CA, Microcomputer Information Services, 1981+ (Also available as File 233 on DIALOG).

Online Micro Software Guide & Directory, edited by Helen A. Gordon, Weston, CT, Online, 1982.

Small Systems Software and Services Sourcebook, Glenview, Illinois, J. Koolish Information Sources, Inc., 1982.

Software Vendor Directory, Norcross, GA. Hayes Microcomputer Products, Inc., 1982.

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Note: This bibliography contains articles and sources which take a broad view of the subject. For information on specific software programs, refer to the Software Directories.

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Hewin, Larry M. "The Computer Connection," Desktop Computing, September 1982, pp.20-27.

Miastkowski, Stan and George Stewart "Modems: Hooking Your Computer to the World," Popular Computing, December 1982, pp.111-118.

Nichols, Elizabeth A. Data Communications for Microcomputers, Englewood Cliffs, NJ. Prentice-Hall, 1982.

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Rorvig, Mark E. Microcomputers and Libraries: a Guide to Technology, Products and Applications, Knowledge Industry Publ., 1981.

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Tangorra, Joanne K. "Wanted: Micro-to-Mainframe Software," MIS Week, August 11, 1982 pp.1+

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